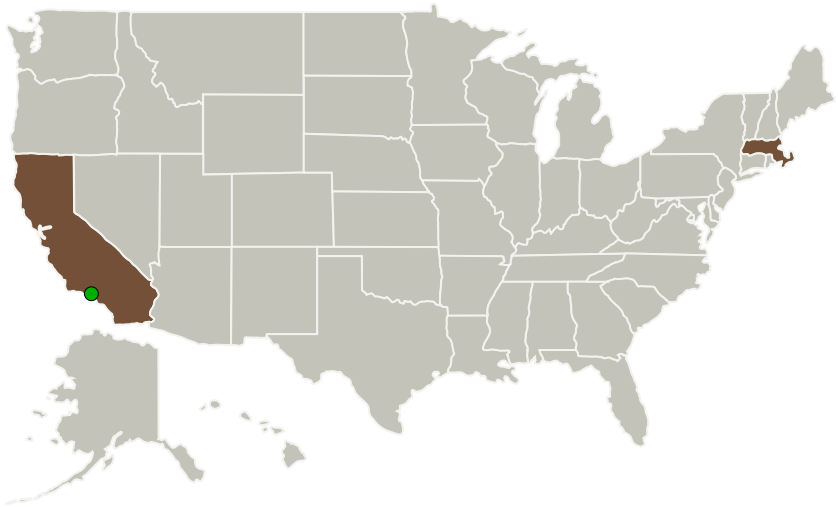
Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

The processing of carbon dioxide is a continuing NASA need, ranging from separation processes to remove it from cabin air, to reaction processes that convert the Martian atmosphere to fuels. In support of future habitation activities on Mars, it is desired to process this high Martian concentration of carbon dioxide to ethylene, a chemical precursor that can be used to subsequently produce plastics including polyethylene, propylene, and polypropylene for building structures. Additionally, ethylene can be readily converted to ethanol and subsequently to sugar, nutrients that support biohabitation. Toward this goal, Reactive Innovations, LLC proposes to develop an electrochemical micro-channel reactor that can convert carbon dioxide to ethylene. The modular architecture of the micro-channel reactor enables the system to be scaled to increase throughput while the small feature sizes of the reactor enhance thermal and mass transfer processes increasing the ethylene yield. During this Phase I program, the electrochemical reactions will be optimized to convert CO2 to ethylene maximizing the yield and rate. Single channel and multiple micro-channels will be produced using a new fabrication process that produces channels on the order of 100 microns wide. Characterization of the micro-channel reactor operating conditions will be conducted while producing ethylene to aid in scaling the process to larger production rates. Conversion of ethylene to polyethylene plastic will subsequently be demonstrated.

Primary U.S. Work Locations and Key Partners



Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I

Table of Contents

Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I

Completed Technology Project (2016 - 2016)

Organizations Performing Work	Role	Type	Location
Reactive Innovations, LLC	Lead Organization	Industry	Westford, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

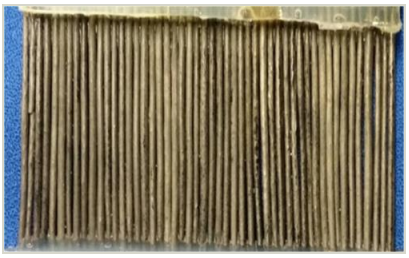
June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140335)*

Images



Briefing Chart Image
Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I
(https://techport.nasa.gov/image/130786)

Final Summary Chart Image
Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I Project Image
(https://techport.nasa.gov/image/130372)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Reactive Innovations, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

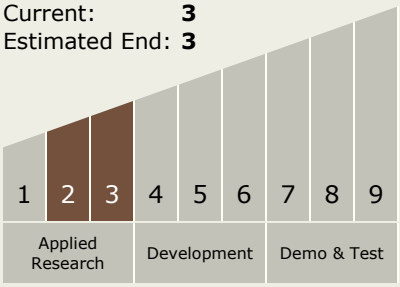
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Daniel Carr

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Micro-Channel Reactor for Processing Carbon Dioxide to Ethylene, Phase I

Completed Technology Project (2016 - 2016)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System